

HABITABLE PLANETS

This activity encourages a discussion about what makes a planet habitable. By the end of the activity, everyone should realize that for a planet to support life like we find on Earth, it must have:

- (a) the right **TEMPERATURE** range for there to be *liquid water*, and
- (b) the right **SIZE** range to be able to have suitable *atmosphere*.

The technique that will stimulate ideas is inspired by the game *Dictionary*.

In this activity, the same question is written on two or more “question cards” (slips of paper) and handed out to people. Only one of the cards has a correct answer printed on it. Each card holder who does *not* have a correct answer already printed on the card makes up an *incorrect* yet plausible answer to the question and writes that answer on the paper. The person with the correct answer printed on her card pretends to write down an answer. Then each person reads their answer and everyone votes on who stated the correct answer.

In each round of *Dictionary*, a leader picks from a dictionary a word that no one knows the definition of. Each person writes a definition that is wrong, yet seems plausible. The leader reads all the definitions in random order, including the right one, which she has written down also. Then everyone votes on which definition is the right one.

Materials

For the whole group/class:

- 1 Set of 12 Question Cards with answers (master on p. 4)
- 2 Sets of 12 Question Cards (total 24 cards) without answers (master on p. 5)
- 1 scissors or paper cutter

Optional: a poster of the rules of the game of “Plausible Answer”

For each person:

- 1 pencil or pen

Preparation

Make a set of question cards by photocopying the master pages and cutting them along the dashed lines. For a large class, make more than one copy of cards *without* answers. Each person will get two or three cards. Arrange the cards in easy-to-hand-out stacks with two or three cards per stack (3/stack for small groups of people or 2/stack for larger groups of people). Make sure each stack of cards has no two identical questions.

Optional: Make a poster of the rules of the game, “Plausible Answer.”

→ Go

1. Explain the rules of the game “Plausible Answer”:

- I. Hand out Question Cards.
- II. Write plausible answers. If you have the right answer already written on your card,, pretend to write on your card.
- III. For each question, one person reads the question and all the answers. Vote on which answer you think is the correct one.

2. Give an example of how to play the game with the question, “Do other stars besides our Sun have planets?” Explain that, while a simple *yes* or *no* answer may be plausible, the object of the game is to get people to vote for your answer, so it’s better to compose an answer that is more than just a simple *yes* or *no*. Read aloud to the class correct and incorrect answers as follows:

- (a) We have solid evidence of over 100 planets outside our solar system.
- (b) It's highly likely that other stars have planets, but no discoveries have been confirmed.
- (c) Yes, over 1000 planets have been discovered around other stars.

Have students vote on which is the correct answer. Answer “a” is the only correct one, but after the NASA Kepler mission (search for terrestrial planets scheduled for launch in 2007), the number in answer “c” may need to be increased in order to still be incorrect.

3. Play the game of “Plausible Answer.”

- a. Hand out the question cards. There are a total of 36 cards, with only 12 having correct answers written on them. Unless there are 12 or fewer people in the group, not everyone will have a card with a correct answer on it.
- b. Allow time for students to write answers.
- c. Begin with the first question. Ask, “Who has the card with the answer to question 1 on it?” Have that person read the question, but NOT the answer. **Question 1. What is the meaning of the term “habitable planet?”**
- d. Ask for each person with a Question 1 card to hand their card to the person with the correct answer on it. That person then shuffles the cards and *dispassionately* reads each of the answers. Alternatively, the answers may be read by a random volunteer in the group.

4. Make the key question of the game obvious.

After each round/question (except for the first question), ask how the question relates to the question “What makes a planet habitable?” This question thus becomes the refrain of the activity.

5. Optional: Switch from the game to a simple group discussion.

At any point during the activity, you may elect to switch from playing the *Plausible Answer* game to simply having the students read each question aloud and having class discussion to arrive at a correct answer. If or when you decide to use this option depends largely on how students are reacting to the game. If it is exciting and producing creative thought and discussion, then the game can be played for all 12 questions.

Here are a few extra things to keep in mind with some of the questions:

Question 2. What are two very important substances on Earth for life?

There are more than two correct answers for this, so expect some discussion.

Question 3. What percent of our bodies is water?

The adult human body is about 60% water based on body weight. This figure can vary from 50% to 70% primarily due to differences in body fat. As body fat increases, the percent weight of water decreases since fat contains less water than other types of tissues. Coincidentally, the percentage of the Earth's surface that is covered by water is about 70%

Question 4. What state must water be in to support Earth-type life: solid, liquid or gas?

Note: This is a pretty easy question, so interrupt the game and pursue this just a bit by asking “Why?” Can you live if the water in you is frozen? Can you live if the water in you is boiling?

Question 5. What temperature range is liquid water?

After this question it’s good to summarize the key point of the questions so far:

Without liquid water, a planet cannot support life. Then ask, “What’s another important substance for life—without which you would die in minutes?” [Correct answer: air, ...]

Question 12. Could there be life on Jupiter? Why or why not?

After question 12, summarize the key point that planet size is an important factor in habitability.

6. Ask, “What does it mean to say that finding a habitable planet is sort of like the story of Goldilocks?”

[SIZE and TEMPERATURE of the planet are keys to their habitability. If a planet is too cold it can’t support life. If it’s too hot, it can’t support life. If it has *just the right temperature* (as Goldilocks would say) to have liquid water, then there can be life. Likewise, if a planet is too small, it doesn’t have enough gravity to hold an atmosphere. If it’s too large, it holds too much atmosphere. If it’s *just the right size* (as Goldilocks would say), it can have the perfect atmosphere for life.]

7. Conclude by asking: “So what are the two most important things a planet must have to be habitable?”

[The right temperature and the right size.]

8. Explain that the NASA Kepler mission is designed to be able to determine the size of a planet as well as its temperature.

The group can visit to the Kepler website to find more about that mission, e.g.

How does Kepler find planets?

How small a planet can Kepler detect?

When will the Kepler spacecraft be launched?

Kepler website:

<http://www.kepler.arc.nasa.gov>

A very interesting additional activity or demonstration that would be great to do as an interlude after question 5 is to measure temperature of ice and of boiling water. The actual temperature of an ice water mixture depends on how much impurity (such as salt) is in the water. The actual temperature of boiling water depends on the atmospheric (barometric)

1. What is the meaning of the term
“habitable planet?”

[answer: A planet that has everything needed
for life]

7. What do you think keeps our air from
flying off into space?

[answer: gravity]

2. What are two very important
substances on Earth for life?

[answer: Water and air.]

8. Which is bigger, Earth or Moon?
How much bigger in diameter?

[answer: Earth is bigger—about 4 times
the diameter]

3. What percent of our bodies is
water?

[answer: Anywhere from 50% to 70%]

9. Does the Moon have air? Why not?

[answer: The Moon does not have air
because it does not have enough gravity
to hold air]

4. What state must water be in to
support Earth-type life: solid, liquid or
gas?

[answer: Liquid.]

10. Which is bigger, Earth or Jupiter?
How much bigger in diameter?

[answer: Jupiter is bigger than Earth by
a factor of about 10]

5. What temperature range is liquid
water?

[answer: 0° to 100° Celsius
[or 32° to 212° Fahrenheit]

11. What kind of planet is Jupiter
sometimes called?

[answer: gas giant or giant planet]

6. What keeps us stuck to the ground and
not flying off the Earth?

[answer: gravity]

12. Could there be life on Jupiter?
Why or why not?

[answer: probably not, since the
atmosphere is so thick and there’s no
liquid water.]

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